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**Biology of Mutualisms.** D. H. Boucher (ed.). 1985. Oxford University Press (paperback issued 1988).

Since its publication, this excellent volume has been reviewed from an ecological perspective many times (e.g., Beattie, 1986; Goodman, 1986; Wilson, 1986; Thompson, 1987). I therefore depart from the traditional role of reviewers and take this opportunity to offer a phylogeneticist's view of what might be included in the next volume on this fascinating and rich field of study.

The included chapters in the *Biology of Mutualisms*, *Ecology and Evolution* volume are uniformly microevolutionary in treatment and thus parallel the state of the field—to date there have been no phylogenetic studies of mutualistic associations. At present, we have no information on, for example, which qualities of particular mutualisms reflect evolution in situ vs. phylogenetically ancient traits or how participants are gained or lost to such associations.

While Ehrlich and Raven's model of coevolution has served to organize research of antagonistic interactions at both micro- and macroevolutionary levels, no such organizing influence has been realized in the study of mutualisms. For whatever reason—if because mutualistic interactions are more often “diffuse” or involve disparate, comparatively little-known taxa—broad macroevolutionary patterns for mutualisms are less well known than for plants and herbivores. It is entirely possible that the associations of mutualistic species are not as evolutionarily persistent as for plant/herbivore interactions, perhaps for the reasons elaborated in chapters devoted to modelling the interactions by Dean, Keeler, Lane, Law, Post et al., Vandermeer et al., and Wolin. However, while phylogenetic evidence that would bear on the issue is virtually nonexistent, many of the papers in this volume make specific macroevolutionary predictions testable by phylogenies. If mutualisms evolve, then phylogenies should provide evidence on whether, for example, they become more efficient, or if there is directional evolutionary change in the obligate/facultative nature of interactions or in the degree of specialization (as postulated in the chapters by Cook, Law, Soberon and Martinez del Rio and by Templeton and Gilbert).

More specifically, Janzen's contribution offers innumerable hypotheses testable with phylogenies such as whether plants dispersed by animals sequentially evolve greater ornamentations, coupled with greater seed protection and whether lineages of seed-dispersing animals evolve greater “sloppiness” or efficiency (as predicted). For ant/plant mutualisms, one might ask whether plant-ants are derived only from arboreal ancestors and whether ant-plants are similarly derived from a few phylogenetic sources “pre-adapted” to mutualisms. Does entry into such mutualisms influence the subsequent diversification and distribution of either partner, or otherwise alter the scope of evolutionary opportunities? So far little is known of the marks of phylogenetic history on the structure, assembly and diversity of mutualistic communities.

Thus, while the volume edited by Boucher should certainly serve to focus future research at microevolutionary levels (facilitated by the insightful overviews of the conceptual and historical bases of mutualism theory provided in chapters by Boucher

and Lewis), such inquiries should be enriched by systematic scrutiny of the macro-evolutionary questions suggested therein (and those common to antagonistic interactions as well). While a few of the major evolutionary ecological paradigms of the 60's (e.g., plant/herbivore coevolution, insect sociality) are now receiving scrutiny by systematists, the theory of mutualisms nicely encapsulated in Boucher's volume presents a rich source of untested evolutionary scenarios for the present generation of phylogeneticists.

In sum, these volumes edited by Boucher and by Stone and Hawksworth should be on the bookshelf of any scientist interested in *both* the evolution and ecology of interspecific interactions. The future of evolutionary biology should thus be brightened by new syntheses of phylogenetic research with the population biologies of ecological associations.—*Brian D. Farrell, Department of Entomology, University of Maryland, College Park, Maryland 20742.*

#### REVIEWS CITED

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